38. (New) The method of claim 18 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

39. (New) The method of claim 38 wherein said phosphorus-containing source is PH_3.

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40. (New) The method of claim 31 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

41. (New) The method of claim 40 wherein said phosphorus-containing source is PH_3.--

REMARKS

Claims 25-41 have been added and claims 1-24 remain unchanged. Thus, claims 1-41 are pending.

Claims 1, 2, 3 and 4 stand rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al. (USP 6,258,407).

Claims 5, 6, 7, 8 and 9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. and further in view of Applicants prior art.

Claims 10-24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants prior art and in view of Lee et al.

As amended, all the pending claims of the subject application comply with all requirements of 35 U.S.C. Accordingly, Applicant requests examination and allowance of all pending claims.

Formal Matters

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings to Show Changes Made."

The Rejection Under 35 U.S.C. 102(e)

Claims 1, 2, 3 and 4 stand rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al. (USP 6,258,407). This rejection is traversed.

In making the above rejection, the Examiner references Figs. 1-6 of Lee et al. and states:

> "Lee discloses a method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:
> flowing a process gas into the substrate processing chamber 120, said process gas comprising a silicon-containing source SiH_4 (column 1, line 63), an oxygen containing source H_2O_2 (column 1, line 63) and a fluorine-containing source C_2F_6 (column 2, lines 32);
> forming a plasma from said process gas; and
> heating the substrate 140 to a temperature above 450°C during deposition of said silicon oxide 620." Office Action, Page 2, Section number 3.

As is well known to the Examiner, in order for a reference to anticipate a claim, the reference must disclose each element of the claimed invention *as arranged in the claim.* Thus, even if a single prior art reference includes all the elements that are claimed, anticipation cannot be found if the arrangement of the claimed elements is different from the arrangement of the prior art elements. Such is the case here.

In reviewing the Rejection in detail, Applicants respectfully assert that the Examiner has picked isolated elements from a multitude of different embodiments disclosed in the Lee et al. patent and improperly combined them as part of an anticipation rejection. For example, as recited above, the Examiner argues that Lee discloses a method of forming a high density plasma CVD silicon oxide layer using a process gas comprising SiH_4, H_2O_2 and C_2F_6. In support of this position, the Examiner references col. 1, line 63 as disclosing SiH_4 and H_2O_2 gases and col. 2, line 32 as disclosing the C_2F_6 gas. At col. 1, line 63, however, the Lee patent is discussing the formation of a thermal CVD layer (not a high density plasma CVD process as recited in claims 1-4) using SiH_4 and H_2O_2 gases, and at col. 2, line 32, the Lee patent is describing a high density plasma process to deposit amorphous carbon and fluorinated amorphous carbon films (not silicon oxide film as recited in claims 1-4).

As another example, the Examiner does not point to a particular section of the Lee patent in stating that it teaches heating the substrate to a temperature above 450°C during deposition of a silicon oxide layer. Applicants note that in the two different film formation process disclosed at col. 1, line 63 and col. 2, line 32 referenced as teaching the claimed process gas, no details of the temperature of the deposition processes employed to form the films are recited. In rejecting claim 3 under Section 102(e) in view of the Lee patent, however, the

Examiner states Lee discloses maintaining the substrate "at a temperature of 500°C" at column 11, line 67. The process disclosed at col. 11, line 67 of the Lee patent, however, is a thermal CVD process, not a plasma CVD process as recited in claims 1-4.

In view of the above, Applicants respectfully assert that a case of anticipation under Section 102(e) of claims 1-4 has not been established. Accordingly, Applicants request withdrawal of the Rejection and allowance of claims 1-4.

The Rejections Under 35 U.S.C. 103(a)

Claims 5-9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. and further in view of Applicants prior art. This rejection is also traversed.

The Rejection of claims 5-9 is premised on the Examiner's belief that the Lee patent anticipates independent claim 1 from which each of claims 5-9 depend. As described above, Lee et al. does not anticipate claim 1 as it does not teach or disclose a high density plasma comprising (a) flowing a process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine-containing source into a substrate processing chamber; (b) forming a plasma from the process gas and (c) heating a substrate to a temperature above 450°C during deposition of the silicon oxide layer. None of the prior art references on record, including Applicants admitted prior art, make up for these deficiencies in the Lee et al. reference. Accordingly, Applicants respectfully assert that the rejection of claims 5-9 under Section 103 be withdrawn and that a notification of the allowance of these claims be sent.

Claims 10-24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants prior art and in view of Lee et al. This rejection is also traversed.

The Rejection states that Applicants admitted prior art discloses a process as substantially claimed in claims 10-24. Specifically, the Rejection notes that:

> "pages 2-3 of Applicants disclosure ... teach a method for forming a silicon oxide layer over a substrate disposed in a high density substrate processing chamber, said method comprising:
> (a) flowing a first gas (Ar and O_2) into the substrate processing chamber;
> (c) flowing a process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine-containing source into said substrate processing chamber." Office Action, page 5, section number 14.

The Office Action acknowledges that Applicants admitted prior art does not teach heating the substrate to a temperature at or above 450°C during deposition of the high density

plasma oxide layer but argues that Lee et al. makes up for this deficiency in the primary reference. Specifically, the Rejection states that at cols. 11 and 12 Lee et al. teaches heating a wafer to 500°C and forming a high density plasma having an ion density of at least 1×10^{11} ions/cm^3. At columns 11 and 12, however, Lee teaches a variety of different processes to deposit fluorinated SiO_2 films. At col. 11, line 56 to col. 12, line 3, Lee teaches a thermal CVD process that heats the wafer to a temperature between –20°C to 500°C to form an F-modified SiO_2 film. This process is not a high density plasma process as the Examiner seems to believe. Similarly there is no disclosure at col. 12 (or anywhere else within Lee for that matter) of a high density plasma process that heats the wafer to a temperature of 500°C as the Examiner seems to believe. Accordingly, Applicants respectfully request withdrawal of the Section 103 rejection of claims 10-24 as well as allowance of these claims.

Applicants also request that the Section 103 rejection of claims 10-24 be withdrawn because Applicants admitted prior art does not disclose all the limitations that the Examiner states is discloses. Specifically, claim 10 recites forming a plasma from a first gas and thereafter forming a plasma from a process gas. The first gas and process gas are different gases. Nothing on pages 2-3 of Applicants' specification is this aspect of the invention of claim 10 taught or suggested. Similarly, claim 17 recites forming a plasma from a first gas comprising an inert gas and O_2 and thereafter, forming a plasma from a process gas comprising SiH_4, O_2 and a fluorine source. Again, such a multistep process is also not disclosed or suggested by Applicants admitted prior art. Thus for this additional reason, Applicants respectfully request withdrawal of the section 103 rejection and allowance of the claims.

Comments on Selected Additional Claims:

Claim 6, which depends on claim 1 and is believed to be in condition for allowance for at least the same reasons as set forth above for claim 1, further recites that the fluorine content of the deposited film is less than 1.0 atomic percent even though a fluorine source is added to the process gas. The Rejection states that this limitation is obvious because Applicants admitted prior art teaches many semiconductor manufacturer's desire to produce oxide films for PMD and STI applications having less than 1.0 at. % fluorine in the films. The Examiner's rationale for applying Applicants admitted art with the Lee reference is that it would be obvious to a person of ordinary skill in the art to incorporate so little fluorine into the film to

reduce the likelihood the fluorine would outgas and migrate into an adjacent layer. Such rationale, however, ignores the true teaching of Applicants admitted art. Specifically, page 3, lines 12-20 of applicants application states that semiconductor manufacturers are particularly hesitant to include fluorine into PMD and STI films because such films are likely to be subject to relatively high temperatures during later processing. Thus, the portion of Applicants admitted prior art relied upon by the Examiner in making this rejection teaches away from including fluorine in deposition of PMD and STI films – it does not suggest including just a little bit as suggested by the Examiner. Accordingly, Applicants respectfully assert that claim 6 is allowable over the art of record for this additional reason.

Claim 15, which depends from claim 10 also recites that the fluorine content of the deposited film is less than 1.0 atomic percent even though a fluorine source is added to the process gas. Thus, claim 15 is believed to be allowable over the art of record for reasons similar those set forth above with respect to claim 6.

Independent claim 17 also recites that the fluorine content of the deposited film is less than 1.0 atomic percent even though a fluorine source is added to the process gas. Thus, claim 17 is believed to be allowable for this additional reason also.

Comments on New Claims:

New claims 25-33 have been added to secure an appropriate scope of protection for the present invention. Support for these claims exists in the Specification as originally filed. For example, support for claims 25-27 and 30 exists at least on page 3, lines 30-31; support for claim 28 exists at least in the text associated with Fig. 2; support for claim 29 exists at least at page 2, lines 9-11; and support for claims 31-33 also exists at least in the text associated with Fig. 2. Examination and allowance of these claims is respectfully requested.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Paragraph beginning at line 25 of page 8 has been amended as follows:

Gas ring 37 also has a plurality of gas nozzles 40 (only one of which is shown), which in a preferred embodiment are co-planar with and shorter than source gas nozzles 39, and in one embodiment receive gas from body plenum 41. Gas nozzles 39 and 40 are not fluidly coupled in some embodiments it is desirable not to mix gases before injecting the gases into chamber 13. In other embodiments, gases may be mixed prior to injecting the gases into chamber 13 by providing apertures (not shown) between body plenum 41 and gas ring plenum 36. In one embodiment, third and fourth gas sources, 34C and 34D, and third and fourth gas flow controllers, 35C' and 35D', provide gas to body plenum via gas delivery lines 38. Additional valves, such as 43B (other valves not shown), may shut off gas from the flow controllers to the chamber.

Paragraph beginning at line 25 of page 10 has been amended as follows:

System controller 60 operates under the control of a computer program 63 stored in a computer-readable format within memory 62. The computer program dictates the timing, temperatures, gas flows, RF power levels and other parameters of a particular process. The interface between a user and the system controller is via a CRT monitor 65 and a light pen 66, as depicted in Fig. 1C. In a preferred embodiment, two monitors, 65 and 65A, and two light pens, 66 and 66A, are used, one mounted in the clean room wall **[(65)]** for the operators and the other behind the wall **[(65A)]** for the service technicians. Both monitors simultaneously display the same information, but only one light pen (e.g. 66) is enabled. To select a particular screen or function, the operator touches an area of the display screen and pushes a button (not shown) on the pen. The touched area confirms being selected by the light pen by changing its color or displaying a new menu, for example.

IN THE CLAIMS:

Please add new claims 25-41 as follows. Note that claims 1-24 remain unchanged, but are reproduced below for the Examiner's convenience and reference.

1. (Unchanged) A method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

flowing a process gas into the substrate processing chamber, said process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine-containing source;

forming a plasma from said process gas; and

heating the substrate to a temperature above 450°C during deposition of said silicon oxide layer.

2. (Unchanged) The method of claim 1 wherein the substrate is heated to a temperature above 500°C during deposition of said silicon oxide layer.

3. (Unchanged) The method of claim 1 wherein the substrate is maintained at a temperature between 500-600°C during deposition of said silicon oxide layer.

4. (Unchanged) The method of claim 1 wherein said silicon-containing gas is SiH_4.

5. (Unchanged) The method of claim 1 wherein said oxygen-containing source is O_2.

6. (Unchanged) The method of claim 1 wherein said silicon oxide layer has a fluorine content of less than 1.0 at. %.

7. (Unchanged) The method of claim 6 wherein said fluorine-containing source is either NF_3 or a fluorocarbon having a formula of C_nF_{2n+2} where n is a positive integer.

8. (Unchanged) The method of claim 7 wherein the plasma has an ion density of at least 1×10^{11} ions/cm^3.

9. (Unchanged) The method of claim 1 wherein a flow ratio of said oxygen-containing source to said silicon-containing source is between 1.4-3.0:1 inclusive.

10. (Unchanged) A method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

(a) flowing a first gas into the substrate processing chamber;

(b) forming a plasma having an ion density of at least 1×10^{11} ions/cm^3 from said first gas and allowing said plasma to heat said substrate;

(c) thereafter, flowing a process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine-containing source into said substrate processing chamber; and

(d) forming a plasma having an ion density of at least 1×10^{11} ions/cm^3 from said process gas and allowing said plasma to heat said substrate to a temperature at or above 450°C during deposition of said silicon oxide layer.

11. (Unchanged) The method of claim 10 wherein said oxygen-containing source is O_2 and said silicon-containing source is SiH_4.

12. (Unchanged) The method of claim 11 wherein said first gas comprises one or more of argon and O_2.

13. (Unchanged) The method of claim 10 wherein said fluorine-containing source is either NF_3 or a gas having the formula of C_nF_{2n+2} where n is a positive integer.

14. (Unchanged) The method of claim 13 wherein a flow ratio of said oxygen-containing source to said silicon-containing source is between 1.4-3.0:1 inclusive.

15. (Unchanged) The method of claim 10 wherein said silicon oxide layer has a fluorine content of less than 1.0 at. %.

16. (Unchanged) The method of claim 10 wherein in (d) said plasma heats said substrate to a temperature of 500°C or more.

17. (Unchanged) A method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

(a) flowing a first gas comprising at least one of an inert gas and O_2 into the substrate processing chamber;

(b) forming a plasma having an ion density of at least 1×10^{11} ions/cm^3 from said first gas and allowing said plasma to heat said substrate;

(c) thereafter, depositing said silicon oxide layer by flowing a process gas comprising SiH_4, O_2 and a fluorine-containing source into said substrate processing chamber while maintaining said plasma and allowing said plasma to heat said substrate to a temperature above 450°C during deposition of said silicon oxide layer;

wherein said silicon oxide layer has a fluorine concentration of 1.0 at. % or less.

18. (Unchanged) The method of claim 17 wherein said silicon oxide layer has a fluorine content of 0.6 at. % or less.

19. (Unchanged) The method of claim 18 wherein a flow rate of said fluorine-containing source is greater than or equal to a flow rate of SiH_4.

20. (Unchanged) The method of claim 17 wherein said fluorine-containing source is NF_3.

21. (Unchanged) The method of claim 17 wherein said fluorine-containing source is a fluorocarbon having a formula of C_nF_{2n+2} where n is a positive integer.

22. (Unchanged) The method of claim 17 wherein a flow ratio of said oxygen-containing source to said silicon-containing source is between 1.6-2.5:1 inclusive.

23. (Unchanged) The method of claim 20 wherein a flow rate of NF_3 is between 50-150 sccm and a flow rate of SiH_4 is between 50-150 sccm.

24. (Unchanged) The method of claim 23 wherein a flow rate of NF_3 is greater than or equal to a flow rate of SiH_4.

--25. (New) The method of claim 1 wherein the silicon oxide layer is used as a premetal dielectric layer or part of a shallow trench isolation structure.

26. (New) The method of claim 10 wherein the silicon oxide layer is used as a premetal dielectric layer or part of a shallow trench isolation structure.

27. (New) The method of claim 17 wherein the silicon oxide layer is used as a premetal dielectric layer or part of a shallow trench isolation structure.

28. (New) A method for forming a silicon oxide layer over a substrate disposed in a high density substrate processing chamber, said method comprising:

flowing a process gas a silicon-containing source, an oxygen-containing source and a fluorine-containing source into the substrate processing chamber;

forming a plasma having an ion density of at least 1×10^{11} ions/cm^3 from said process gas; and

biasing the plasma during deposition of the silicon oxide layer to generate a sputter etching component simultaneous with film deposition, wherein the plasma heats the substrate to a temperature at or above 500°C during deposition of the silicon oxide layer.

29. (New) The method of claim 28 wherein the sputtering element of the deposition process slows deposition on corners of raised surfaces the silicon oxide layer is deposited over thereby contributing to the increased gapfill capability of the silicon oxide layer.

30. (New) The method of claim 29 wherein the silicon oxide layer is used as a premetal dielectric layer or part of a shallow trench isolation structure.

31. (New) The method of claim 30 wherein said silicon oxide layer has a fluorine content of 0.6 at. % or less.

32. (New) The method of claim 31 wherein said silicon-containing gas is SiH_4.

33. (New) The method of claim 32 wherein said oxygen-containing source is O_2.

34. (New) The method of claim 1 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

35. (New) The method of claim 34 wherein said phosphorus-containing source is PH_3.

36. (New) The method of claim 10 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

37. (New) The method of claim 36 wherein said phosphorus-containing source is PH_3.

38. (New) The method of claim 18 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

39. (New) The method of claim 38 wherein said phosphorus-containing source is PH_3.

40. (New) The method of claim 31 wherein the silicon oxide layer is doped with phosphorus and said process gas further comprises a phosphorus-containing source.

41. (New) The method of claim 40 wherein said phosphorus-containing source is PH_3.--